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JAPAN PATENT OFFICE

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Applicant(s):	STARTING INDUSTRIAL CO., LTD.

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Commissioner,
Japan Patent Office Yasuo IMAI (Sealed)

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[List of Submitted Documents]

[Title of Document]	Specification	1
[Title of Document]	Drawings	1
[Title of Document]	Abstract	1

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[Proof Required] Yes

[Title of Document] Specification

[Title of the Invention] Recoil Starter

[Claims]

[Claim 1] A recoil starter comprising a drive section which is constituted by a rope reel having a recoil rope wound therearound, a cam disposed adjacent to said rope reel and provided with cam pawls engageable with a ratchet mechanism and a damper spring interposed between said rope reel and said cam, wherein a rotational force of said drive section which is rotationally driven by pulling said recoil rope is transmitted to a rotational member attached to a crankshaft of an engine and provided with said ratchet mechanism via said ratchet mechanism to thereby start the engine, characterized in that:

said rope reel and said cam are provided on joining surfaces thereof with respective annular recesses which are formed to face each other so as to receive said damper spring therein, said damper spring having opposite ends thereof held respectively onto said rope reel and said cam so that said rope reel and said cam are coupled together via said damper spring; and

said cam includes an outer peripheral wall which forms said annular recess thereof and on which a plurality of openings are formed circumferentially apart so that portions of said outer peripheral wall between the adjacent openings each define a cam pawl which is engageable with said ratchet mechanism.

[Claim 2] The recoil starter according to claim 1, characterized in that said outer peripheral wall of said cam forming said annular recess thereof is provided on one side thereof with a flange portion which is radially outwardly extended and integrally formed on said outer peripheral wall, and each of said cam pawls has opposite ends thereof connected to and supported by an inner peripheral rim of said flange portion and a bottom of said annular recess of said cam, respectively.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Pertains]

The present invention relates to a recoil starter, wherein a recoil rope is pulled to rotate a rope reel so that a rotation of the rope reel is transmitted to a cam via a damper spring, and then a ratchet mechanism provided on a rotational member coupled to an engine is engaged with the cam to rotate the rotational member, whereby the engine is started.

[0002]

[Prior Art]

Among recoil starters designed to transmit a rotation of a rope reel, rotated by pulling a recoil rope, to a cam and further rotate a rotational member such as a flywheel magnet or a drive pulley via a centrifugal clutch or other ratchet mechanism which engages with or disengages from the cam, a recoil starter is known which is constructed to absorb a shock, caused due to fluctuations in load during engine startup and transmitted to an operator's hand, by resiliently coupling the rope reel and the cam through a damper spring in the form of a coil spring to transmit a rotation of the rope reel to the cam via the damper spring.

[0003]

In a recoil starter proposed, for example, in Japanese Patent Application No. 2002-144695, as shown in Fig. 7, a damper spring 34 is received within annular recesses 32 and 33 which are formed on opposing surfaces of a rope reel 30 and a cam 31 while one end portion 35 thereof bent in U shape is fitted within a holding groove 36 formed on the rope reel 30 and the other end portion 37 thereof, bent in an axial direction, is inserted into an opening 38 formed in the cam 31. When a rope 39 wound around the rope reel 30 is pulled to rotate the rope reel 30, the cam 31 is rotated via the damper spring 34. As a result, engagement of cam pawls 40 formed on the outer peripheral surface of the cam 31 with a ratchet 42 provided on a rotational member 41 attached to a crankshaft of an engine allows a rotation of the cam 31 to be

transmitted to the rotational member 41, whereby the crankshaft coupled to the rotational member 41 is rotated. When the rotation of the cam 31 is precluded by a startup resistance of the engine, the damper spring 34 is twisted, so that a shock on the rope reel 30 is cushioned and a rotational force of the rope reel 30 is stored in the damper spring 34. When a driving force of the rope reel 30 exceeds the startup resistance of the engine, the rotational force stored in the damper spring 34 is released, so that the rotational member 41 is rotated via the cam 31 to start the engine.

[0004]

[Problem to be Solved by the Invention]

It is desirable that the damper spring 34 interposed between the rope reel 30 and the cam have greater shock-absorbing and force-storing capabilities. While these capabilities can be enhanced by increasing a wire diameter and a winding diameter of the damper spring 34, the sizes of the annular recesses 32 and 33 receiving the damper spring 34 must be increased in outer diameter thereof corresponding to the increase of the wire diameter and winding diameter of the damper spring 34. In the proposed technique, the cam pawls 40 are formed such that the cam pawls 40 protrude outwardly from the outer surface of an outer peripheral wall 43 of the annular recess 33 formed on the cam 31 to receive therein the damper spring 34, as shown in Figs. 8(a) and 8(b). For this reason, it is required that the ratchet 42 engageable with the cam pawls 40 be disposed on an outer peripheral side of the rotational member 41, such as a drive pulley or a flywheel magnet. Therefore, the outer size of the cam 31 is restricted in relation to such parts as the ratchet 42, a cooling fan, the rotational member 41 such as a drive pulley or a flywheel magnet, a casing 44 and the like. Consequently, since the size of the annular recess 33 receiving the damper spring 34 is thus restricted, it is difficult to increase the wire diameter and winding diameter of the damper spring 34 unless the overall

size of the recoil starter is scaled up.

[0005]

The present invention has been made in order to solve the problems associated with the prior art described above. It is therefore an object of the present invention to provide a recoil starter capable of receiving a damper spring with high shock-absorbing and force-storing capabilities without scaling up the overall outer dimensions thereof, and capable of readily starting an engine.

[0006]

[Means for Solving Problem]

In accordance with the present invention, a recoil starter comprising a drive section which is constituted by a rope reel having a recoil rope wound therearound, a cam disposed adjacent to the rope reel and provided with cam pawls engageable with a ratchet mechanism and a damper spring interposed between the rope reel and the cam, wherein a rotational force of the drive section which is rotationally driven by pulling the recoil rope is transmitted to a rotational member attached to a crankshaft of an engine and provided with the ratchet mechanism via the ratchet mechanism to thereby start the engine, is characterized in that: the rope reel and the cam are provided on joining surfaces thereof with respective annular recesses which are formed to face each other so as to receive the damper spring therein, the damper spring having opposite ends thereof held respectively onto the rope reel and the cam so that the rope reel and the cam are coupled together via the damper spring; and the cam includes an outer peripheral wall which forms the annular recess thereof and on which a plurality of openings are formed circumferentially apart so that portions of the outer peripheral wall between the adjacent openings each define a cam pawl which is engageable with the ratchet mechanism.

[0007]

In accordance with claim 2 of the present invention, the

recoil starter is characterized in that the outer peripheral wall of the cam forming the annular recess thereof is provided on one side thereof with a flange portion which is radially outwardly extended and integrally formed on the outer peripheral wall, and each of the cam pawls has opposite ends thereof connected to and supported by an inner peripheral rim of the flange portion and a bottom of the annular recess of the cam, respectively.

[0008]

[Mode for Carrying Out the Invention]

A preferred embodiment of the present invention will now be described with reference to the drawings. A recoil starter according to the embodiment of the present invention, as shown in Fig. 1, is constructed such that when a handle 3 which is joined to one end of a recoil rope 2 exposed outside a casing 1 is pulled, a rope reel 4 constituting a drive section received within the casing 1 is rotationally driven and thus a cam 8 is rotated by the rope reel 4, so that a rotational member 9 coupled to a crankshaft of an engine via a ratchet mechanism 10 which is engageable with cam pawls 11 formed on an outer peripheral surface of the cam 8, to thereby start the engine.

[0009]

As shown in Figs. 2 and 3, the rope reel 4 has the recoil rope 2 wound therearound, of which the one end is drawn outside the casing 1, and is rotatably supported by a support shaft 5 which is integrally formed on an inside of the casing 1 in a manner to be protruded inwardly in the casing 1. The other end of the recoil rope 2 wound around the rope reel 4 is fixed to the rope reel 4. The one end of the recoil rope 2 is drawn outside the casing 1 and has the handle 3 joined to the extremity thereof to manually pull the recoil rope 2. Pulling the handle 3 unwinds a wound portion of the recoil rope 2 from the rope reel 4 to rotate the rope reel 4 about the support shaft 5.

[0010]

A recoil spiral spring 6 is provided between a side surface

of the rope reel 4 and an inner wall surface of the casing 1 so as to rotate the rope reel 4, which has been rotated by pulling of the recoil rope 2, in reverse, to thereby rewind the recoil rope 2 onto the rope reel 4. One end at an inner peripheral side of the recoil spiral spring 6 is fixed to the casing 1 while the other end at an outer peripheral side thereof is fixed to the rope reel 4. As the rope reel 4 is rotated by pulling the recoil rope 2, a rotational force is stored in the recoil spiral spring 6. When the recoil rope 2 is released, the rotational force stored in the recoil spiral spring 6 rotates the rope reel 4 in reverse, resulting in the recoil rope 2 being wound onto the rope reel 4.

[0011]

The cam 8 is mounted, adjacently to the rope reel 4, by a screw 22, to an end face of the support shaft 5 formed on the casing 1 so as to be rotatable, so that the cam 8 transmits a rotation of the rope reel 4 to the crankshaft of the engine. A plurality of the cam pawls 11 are formed on the outer periphery of the cam 8 so that the cam pawls 11 are disengageably engaged with the ratchet mechanism 10 provided on the rotational member 9 which is coupled to the crankshaft of the engine. When one of the cam pawls 11 is engaged with the ratchet mechanism 10 of the rotational member 9, a rotation of the cam 8 is transmitted to the crankshaft of the engine via the rotational member 9. In the illustrated embodiment, the ratchet mechanism 10 is constructed as a centrifugal clutch, so that due to a rotation of the rotational member 9 after startup of the engine, the ratchet mechanism 10 is rotationally moved in a direction of disengaging from the cam pawls 11 by a centrifugal force. As a result, transmission of rotation between the engine side and the cam 8 is interrupted.

[0012]

Annular recesses 12 and 13 are formed respectively on opposing side surfaces of the rope reel 4 and the cam 8 such that

the annular recesses 12 and 13 are opposite to each other. The annular recesses 12 and 13 receive a damper spring 14 therein which rotationally couples the rope reel 4 and the cam 8. As shown in Fig. 4, the damper spring 14 is configured in the form of a torsion coil spring, and has an engaging portion 15 at one end thereof, which engaging portion is formed by bending one end portion of the damper spring 14 horizontally into a U shape. The engaging portion 15 is received within one of holding grooves 16 which are formed on the outside of the annular recess 12 of the rope reel 4 to be contiguous to the annular recess 12, with a result that the rope reel 4 and the damper spring 14 are rotationally coupled together. Another engaging portion 17, bent in an axial direction, is formed on the other end of the damper spring 14. The engaging portion 17 is inserted in a holding hole 18 which penetrates from a bottom of the annular recess 13 to a top side of the cam 8, so that the other end of the damper spring 14 is rotationally coupled to the cam 8.

[0013]

The annular recesses 12 and 13 of the rope reel 4 and the cam 8 include respective inner peripheral surfaces which form bosses 19 and 20 having the same outer diameter. The damper spring 14 is disposed such that end faces of the bosses 19 and 20 are butted against each other substantially at the middle of the coiled portion of the damper spring 14 received within the annular recesses 12 and 13. Such construction allows the coiled portion of the damper spring 14 to wind and tighten substantially uniformly around outer peripheral surfaces of the respective bosses 19 and 20 of the rope reel 4 and the cam 8 when a predetermined rotational force is stored in the damper spring 14 by a startup resistance of the engine, with a result that a further elastic deformation of the damper spring 14 is inhibited and a maximum stress is limited.

[0014]

As shown in Figs. 4 to 6, an outer peripheral wall 26 of the

cam 8 which forms the annular recess 13 is provided with a flange portion 23 which is radially outwardly extended and integrally formed on one side of the outer peripheral wall 26. A plurality of openings 27 are formed circumferentially apart from one another by removing portions of the outer peripheral wall 26 of the cam 8 at a plurality of locations such that the openings 27 penetrate from the inside of the annular recess 13 to the outside of the outer peripheral wall 26. The un-removed portions of the outer peripheral wall 26 between the adjacent openings 27 form the respective cam pawls 11 which are distributed in a circumferential direction. The outer peripheral wall 26 forming the cam pawls 11 have opposite ends connected by an inner peripheral rim of the flange portion 23 and the bottom 28 of the annular recess 13. This allows the damper spring 14 to be received within and supported by the inner peripheral surfaces of the cam pawls 11 and allows engagement surfaces 29 of the cam pawls 11 facing in the circumferential direction to engage with the ratchet mechanism 10, whereby the rotation of the cam 8 is transmitted to the rotational member 9 via the ratchet mechanism 10.

[0015]

Further, the engagement surfaces 29 engageable with the ratchet mechanism 10 are formed on opposite circumferential ends of each of the cam pawls 11 of the cam 8 in a manner to extend in a direction perpendicular to the circumferential direction, as shown in Figs. 4 and 5. In addition, the holding grooves 16, which are formed in association with the annular recess 12 of the rope reel 4 so as to fit therein the engaging portion 15 of the damper spring 14 received in the annular recess 12, are formed symmetrically in the circumferential direction as shown in Fig. 4 such that the holding grooves 16 allow either of damper springs with different winding directions to be fitted therein, resulting in the recoil starter being applicable to both of an engine running in a certain rotational direction and an engine running

in an opposite rotational direction.

[0016]

The cam 8 and the rope reel 4 are incorporated into the casing 1 in the following manner. First, the rope reel 4 is mounted to the support shaft 5 formed on the casing 1. Then, the damper spring 14 is attached to the boss 19 of the rope reel 4 while the engaging portion 15 of one end of the damper spring 14 is fitted within the holding groove 16 of the rope reel 4. Thereafter, the cam 8 is placed on the side surface of the rope reel 4 such that the engaging portion 17 at the other end of the damper spring 14 is inserted into the holding hole 18 formed on the cam 8, and then the screw 22 is fastened to the distal end of the support shaft 5. The cam 8 is supported at its center by a proximal portion of the screw 22 so as to be rotatable with respect to the support shaft 5 and also supported at the outer peripheral side of the flange portion 23 by an annular recessed portion 25 of the rope reel 4 so as to be rotatable, so that inclination of the cam 8 due to an eccentric load acting on the cam 8 can be inhibited and breakage of the cam 8 due to the eccentric load can be prevented.

[0017]

Now, the operation of the recoil starter of the embodiment will be described. Prior to engine startup operations, the ratchet mechanism 10, provided on the rotational member 9 which is coupled to the crankshaft of the engine, is retracted due to the action of a spring and is located at an inner side position where the ratchet mechanism 10 is to come into contact with the cam pawls 11 formed on the cam 8. When the recoil rope 2 is pulled to rotate the rope reel 4, the cam 8 is caused to rotate together with the rope reel 4 via the damper spring 14. The cam pawl 11 of the cam 8 is brought into contact with the ratchet mechanism 10, to thereby rotate the rotational member 9 via the ratchet mechanism 10 and also rotate the crankshaft of the engine coupled to the rotational member 9. At this time, although a

rotational load of the cam 8 increases due to an increase in rotational load resulting from a startup resistance of the engine, the damper spring 14 is twisted to absorb the load, whereby a shock is prevented from being directly transmitted to the recoil rope 2.

[0018]

At this time, twisting of the damper spring 14 results in a rotational force of the rope reel 4 being stored in the damper spring 14. As the damper spring 14 is twisted, the diameter of the coiled portion thereof diminishes, so that the coiled portion thereof is caused to wind and tighten around the bosses 19 and 20 of the rope reel 4 and the cam 8, with the result that no more stress acts on the damper spring 14. The coiled portion of the damper spring is wound and tightened uniformly around the bosses 19 and 20, to thereby couple the rope reel 4 and the cam 8 together as an integral part by the action of the damper spring 14 like a spring clutch, so that a rotation of the rope reel 4 is directly transmitted to the cam 8.

[0019]

At this time, an eccentric load acts on the cam 8 between the cam pawl 11 engaged with the ratchet mechanism 10 and the holding hole 18 supporting the damper spring 14. However, the cam 8 is supported at its center by the screw 22 and supported at the outer peripheral side of the flange portion 23 of a large diameter by the side surface of the rope reel 4, thus inhibiting inclination and deformation of the cam 8 due to the eccentric load.

[0020]

Further, when the rotational force exceeds the startup resistance of the engine as the rope reel 4 is rotated, the rotational force of the rope reel 4 by pulling the recoil rope 2 and the rotational force stored in the damper spring 14 are released to the cam 8, so that the rotational force is transmitted to the rotational member 9 via the ratchet mechanism

10. As a result, the crankshaft of the engine is caused to be rotated abruptly, to thereby start the engine. When the engine starts and the crankshaft rotates, the ratchet mechanism 10 moves rotationally outwardly due to the action of centrifugal force, so that the ratchet mechanism 10 disengages from the cam pawl 11 of the cam 8 to prevent a rotation of the engine from being transmitted to the cam 11. When the recoil rope 2 is loosened after startup of the engine, the rope reel 4 is rotated in the reverse direction by the rotational force stored in the recoil spiral spring 6, whereby the recoil rope 2 is wound onto the rope reel 4.

[0021]

[Effect of the Invention]

As described above, according to the invention, the outer peripheral wall of the annular recess formed on the cam to receive the damper spring is partially removed to form the openings, so that the un-removed remaining portions of the outer peripheral wall form the cam pawls. Therefore, there is no need to form the cam pawls protruding outwardly from the outer peripheral wall of the cam, so that it is possible to enlarge the outer peripheral wall of the annular recess outwardly by as much as the protruded cam pawls which would otherwise be formed. As a result, it is possible to increase the outer diameter of the annular recess without increasing the outer size of the cam, thus allowing the damper spring with a larger wire diameter and a larger winding diameter to be received in the annular recess. Therefore, it is possible to accommodate the damper spring having high shock-absorbing and force-storing capabilities without increasing the outer size of the recoil starter, thus providing an easy-to-operate recoil starter.

[0022]

In addition, in a case where the damper spring having a size identical to that of the conventional one is used, the outer size of the cam can be reduced, so that the rotational member such as

a flywheel magnet, a drive pulley or the like provided on the outside of the cam and the casing containing these parts can be designed to have a reduced size, to thereby provide a compact and lightweight recoil starter.

[0023]

In accordance with claim 2 of the invention, the outer peripheral wall of the cam forming the annular recess thereof is provided on one end thereof with the flange portion which is radially outwardly extended and integrally formed on the peripheral wall such that each of the cam pawls has opposite ends thereof connected to and supported by the inner peripheral rim of the flange portion and the bottom of the annular recess, respectively. Such construction can prevent deformation of the cam pawls when the cam pawls are engaged with the ratchet mechanism.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a front view illustrating a recoil starter according to an embodiment of the present invention.

[Fig. 2]

Fig. 2 is a front view illustrating the recoil starter shown in Fig. 1 with a rotational member removed.

[Fig. 3]

Fig. 3 is a sectional side elevation view of the recoil starter shown in Fig. 1.

[Fig. 4]

Fig. 4 is a perspective view showing a rope reel, a damper spring and a cam used in the embodiment of Fig. 1.

[Fig. 5]

Fig. 5 is a plan view illustrating the cam employed in the embodiment of Fig. 1.

[Fig. 6]

Fig. 6 is a sectional side elevation view of the cam shown in Fig. 5 which has the damper spring received therein.

[Fig. 7]

Fig. 7 is a sectional side elevation view illustrating a conventional recoil starter.

[Fig. 8]

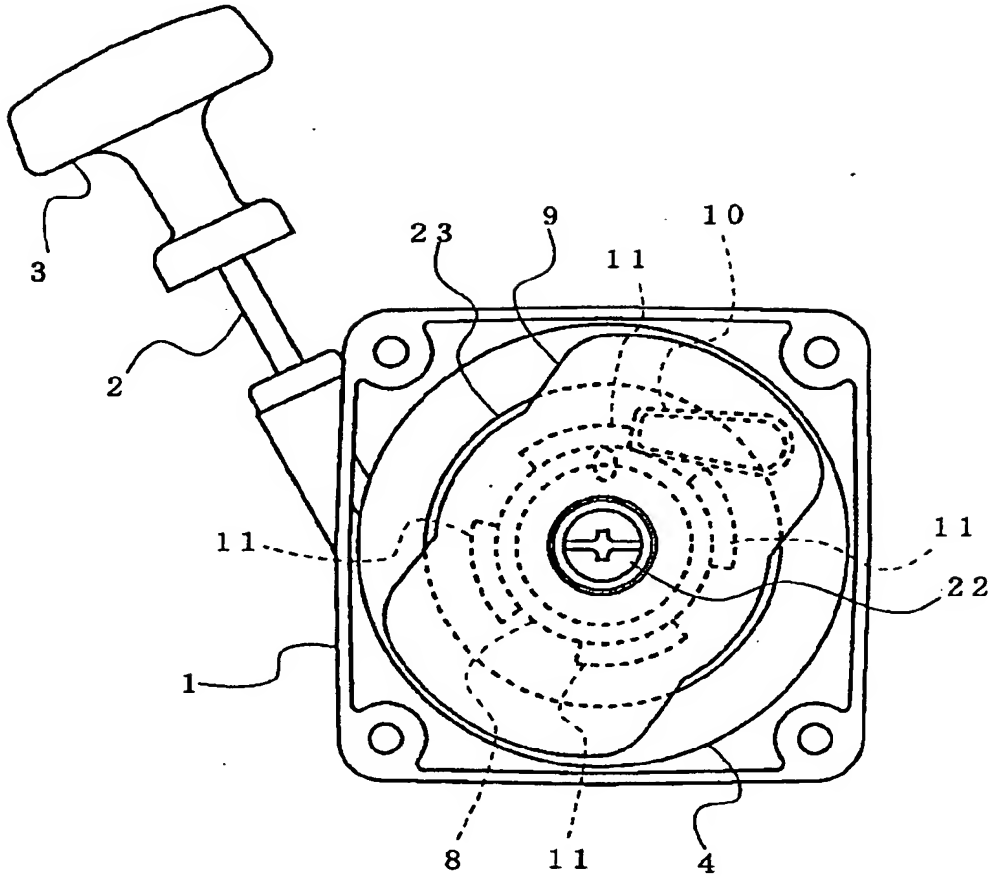
Fig. 8(a) is a perspective view illustrating a cam employed in the conventional recoil starter and Fig. 8(b) is a longitudinal sectional side view of the cam which has the damper spring received therein.

[Explanation of Reference Numerals]

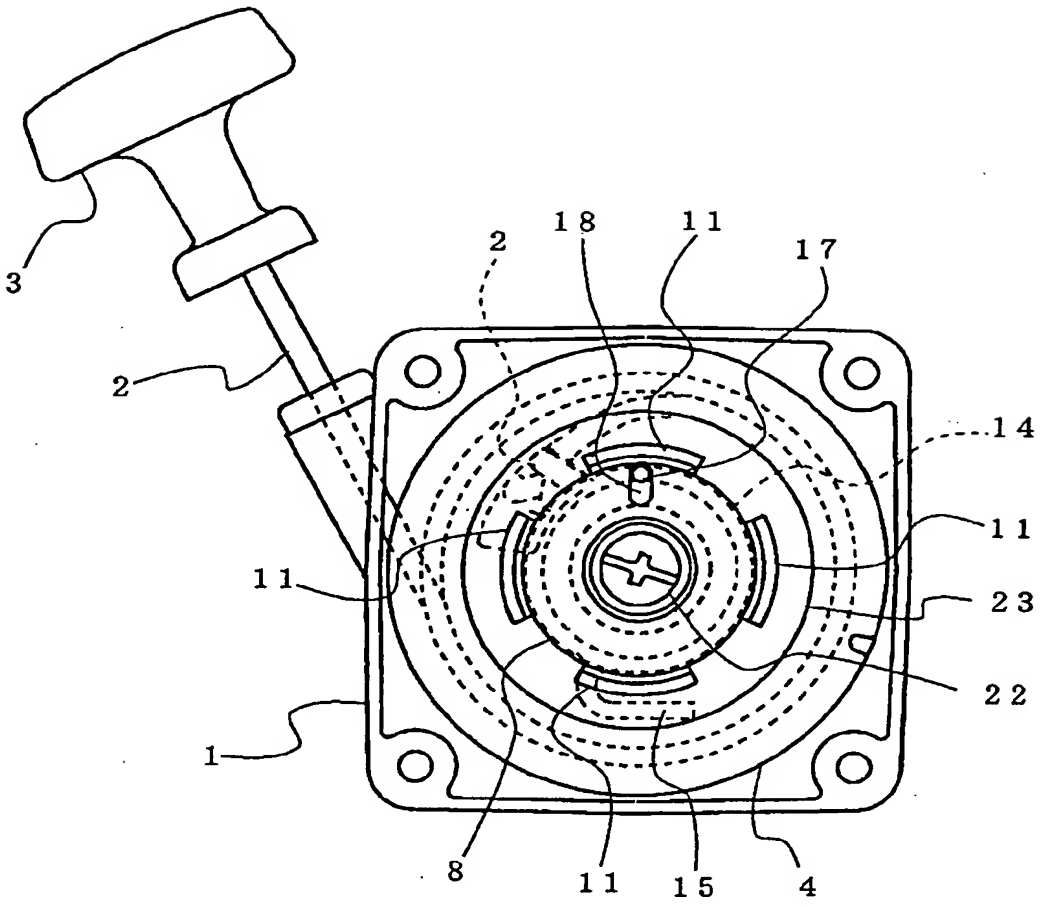
1 Casing
4 Rope reel
8 Cam
9 Rotational member
10 Ratchet mechanism
11 Cam pawl
12 Annular recess
13 Annular recess
14 Damper spring
23 Flange portion
25 Annular recessed portion
26 Outer peripheral wall
27 Opening
28 Bottom
29 Engagement surface

[Title of Document] Drawings

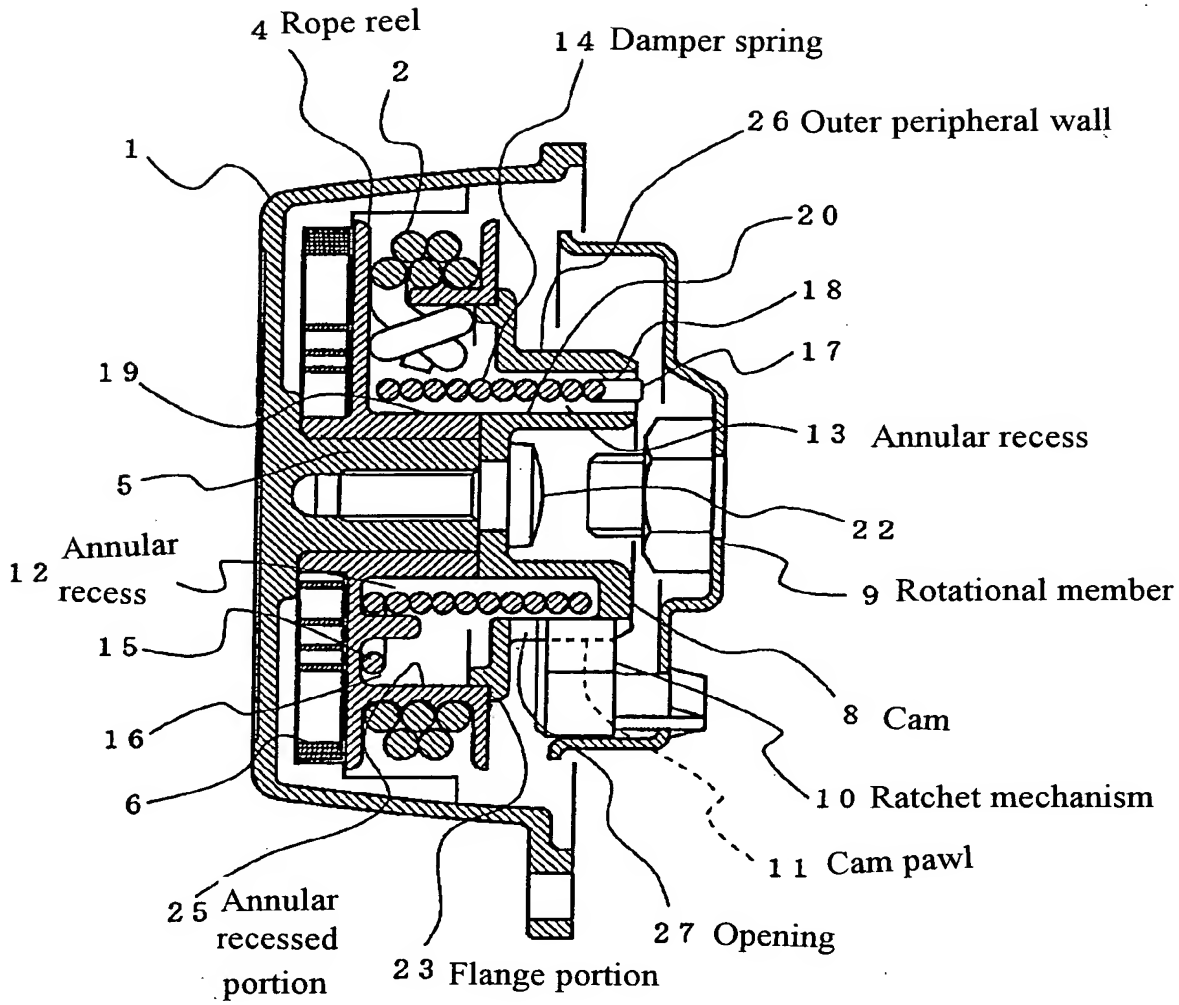
[Fig. 1]



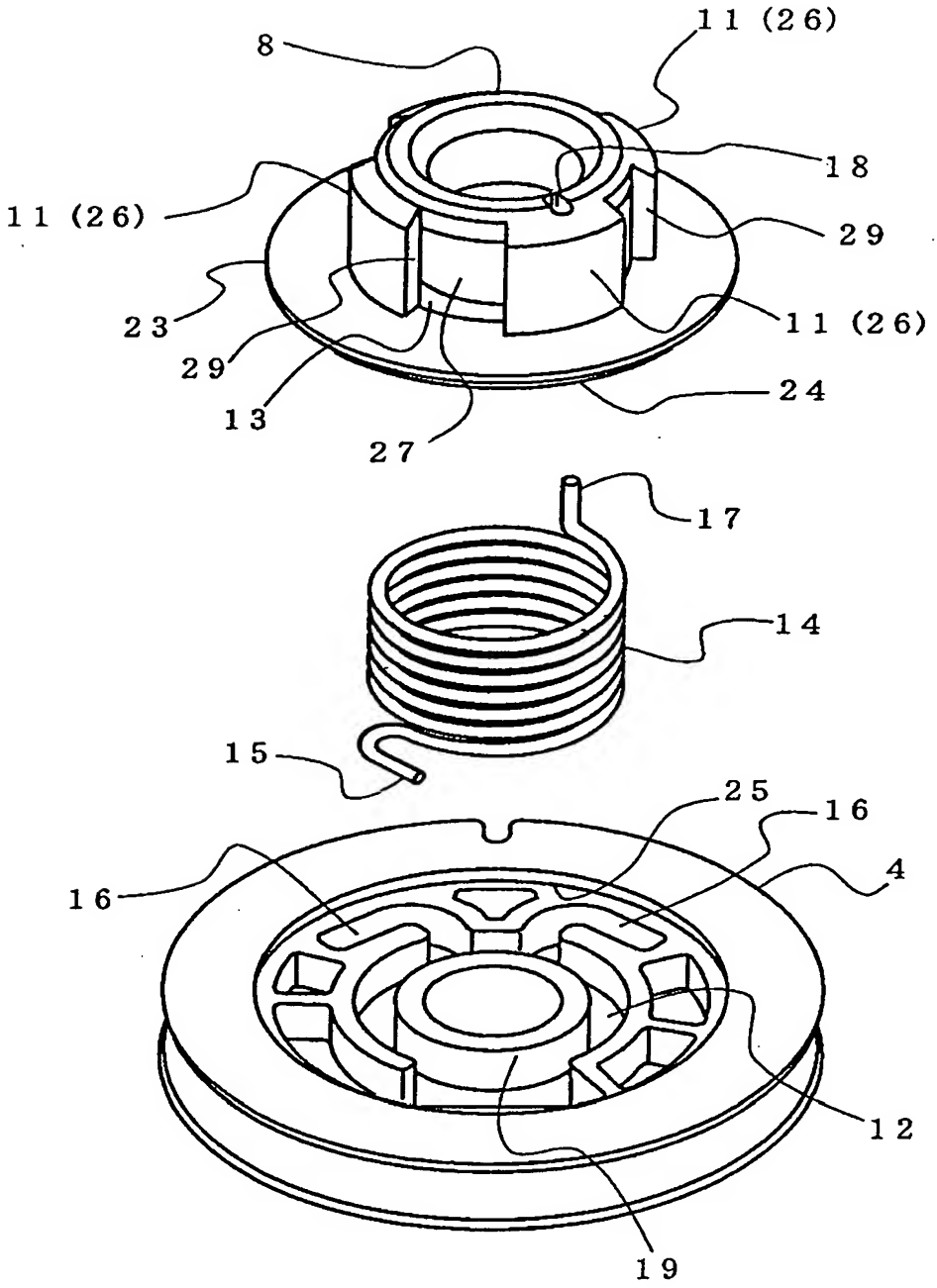
[Fig. 2]



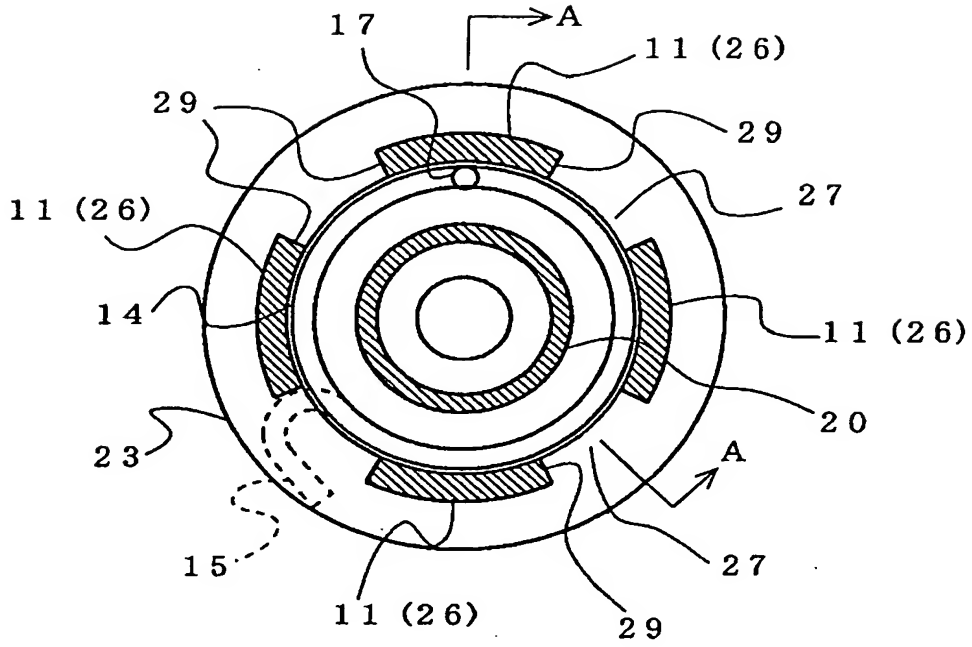
[Fig. 3]


4 Rope reel
2
14 Damper spring
26 Outer peripheral wall
1
20
18
17
19
13 Annular recess
5
22
12 Annular recess
9 Rotational member
15
8 Cam
16
10 Ratchet mechanism
6
11 Cam pawl
25 Annular recessed portion
23 Flange portion
27 Opening

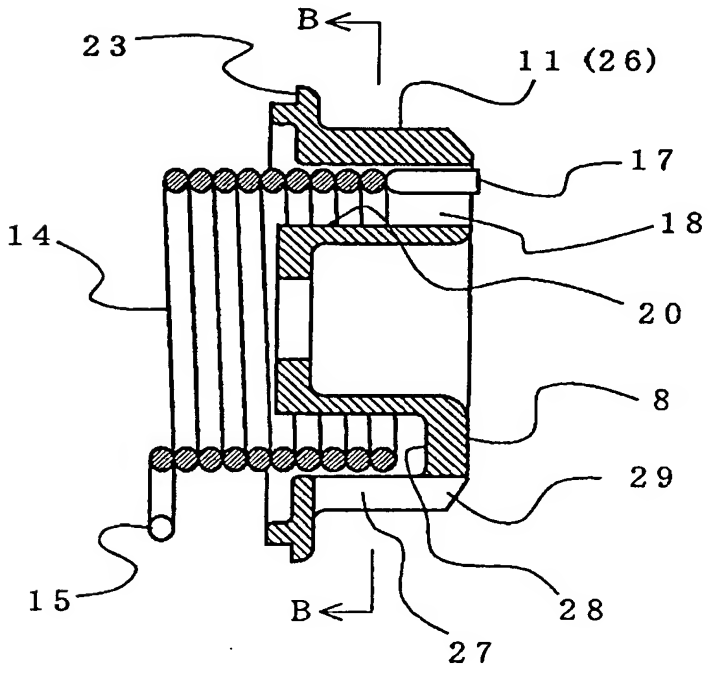
[Fig. 4]



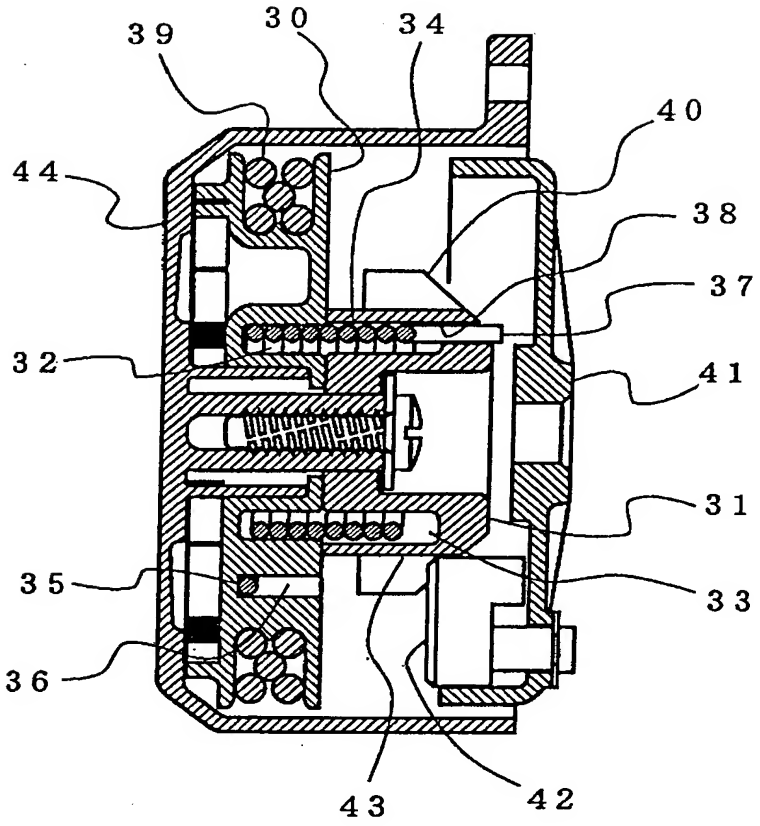
[Fig. 5]


17
A
11 (26)
29
29
27
11 (26)
14
11 (26)
20
23
A
15
27
11 (26)
29

[Fig. 6]


B
23
11 (26)
17
14
18
20
8
29
15
B
28
27

[Fig. 7]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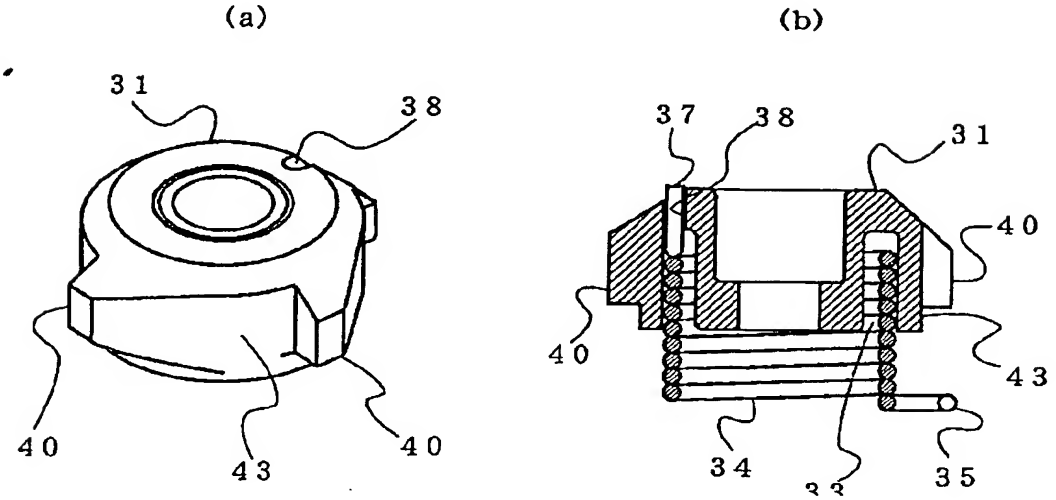
42

[Fig. 8]


(a)
(b)
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40
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34
35

[Title of Document] Abstract

[Abstract]

[Problem to be Solved] To provide a recoil starter capable of receiving a damper spring 14 with high shock-absorbing and force-storing capabilities without increasing the outer size thereof.

[Means for Solving Problem] The recoil starter is so constructed that a recoil rope 2 is pulled to rotate a rope reel 4 and a cam 8 so that a rotation of the cam 8 is transmitted to an engine via a ratchet mechanism, to thereby start the engine. The rope reel 4 and the cam 8 are provided on joining surfaces thereof with respective annular recesses 12 and 13 which are formed to face each other so as to receive a damper spring 14 therein. The rope reel 4 and the cam 8 are coupled together via the damper spring 14 received in the annular recesses 12 and 13. The cam 8 includes an outer peripheral wall 26 which forms the annular recess 13 thereof and on which a plurality of openings 27 are formed circumferentially apart so that portions of the outer peripheral wall 26 between the adjacent openings 27 each define a cam pawl 11 which is engageable with the ratchet mechanism 10.

[Elected Figure] Fig. 3